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RJC J.O. No. 71-102

April 9, 2003

151 Martine Street - Fall River, MA
Office/Laboratory Building Review

This report is submitted in reference to the submission of HVAC system engineering review for the subject project.

Specifically the purpose of this letter is to submit the results of the HVAC systems review for the subject project. The review comments have been enhanced with additional comments for recommended corrective measures for perceived problems. As of this writing there is still outstanding material, as detailed later, which still is not in our possession. This material while important to the overall facility ongoing operations and perhaps to verify some technical data during a fix period was not found to be a hinderance to this overall review.

The HVAC system drawings provided to this office as part of the review process is as described in attachment 'A' to this letter form of report. The apparent missing documentation is listed at the end of that section.

The HVAC system written material provided to this office as part of the review process is as described in attachment 'B' to this letter form of report. The apparent missing documentation is listed at the end of that section.

The HVAC system installation work appears to be missing a variety of documentation which was specified to be provided upon conclusion of the work. The perceived problem is that the original request for proposal, 'RFP' documents appear to clearly call for very detailed closure documentation at the conclusion of the work. There does not appear to be any sort of mechanism by which partially completed work could be documented while the rest of the vacant space was still being marketed.

The following is a list of perceived problems with the existing HVAC systems utilizing the procedures described in our original proposal. Those procedures are included as attachment 'C' to this letter and basically are a repeat of the description of our provision of services. The following recommendations are the result of the described methodology employed in attachment 'C'.

The perceived problems/suggested remedial work are as follows:

1. PENTHOUSE LEVEL OUTDOOR AIR INTAKE LOUVER SIZING

There is an air intake louver at the penthouse level of the facility which serves all 3 air conditioning systems for the building and one penthouse mechanical room heating and ventilating unit. The penthouse level air conditioning units and heating and ventilating unit have a potential peak outdoor air requirement of approximately 71,000 CFM.

The equipment involved is summarized as follows:

Designation	Service	Total Capacity	Min outdoor Air	Economizer
AHU-1	West Wing	24,000 CFM	3,000 CFM	Yes
AHU-2	Center Area	15,000 CFM	2,800 CFM	Yes

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AHU-3	East Wing	29,000 CFM	29,000 CFM	N/A
HV-1	Penthouse	2,000 CFM	2,000 CFM	Yes
Totals	N/A	71,000 CFM	36,800 CFM	

All of this equipment may potentially require full outdoor air under economizer cycle operation. The term 'economizer cycle' refers to periods when the outdoor air temperature is below 55°F and mechanical cooling can be shut down to save electrical energy. During summer periods a mechanical system would draw the minimum outdoor air as indicated in the table above. At approximately 55°F the peak outdoor air flow may be as high as the total CFM indicated in the table above. Below 55°F the amount of outdoor air usually modulates down based upon the amount of facility cooling required. Obviously systems like AHU-3 would not modulate the amount of air required as it is a fixed flow system. Typically in the HVAC trade outdoor air louvers are sized for the worst case scenario or the systems anticipated maximum outdoor air intake. The period when maximum outdoor draw occurs in a case such as this would be when outdoor air temperatures are approximately 55°F. Industry standard outdoor air louvers typically require such outdoor air louvers to be 'weather proof'. This terminology generally refers to the sizing of the louver equipment as well as the design of the individual louver blades to minimize water intrusion.

Typically industry design standards for outdoor air louvers have used 350 FPM as the maximum allowable face velocity and the louver blade design must include a vertical offset to catch incoming rain. For upwards of potentially 72,000 CFM of outdoor the required louver size would be approximately 208 square feet.

The existing penthouse outdoor air louver is sized at approximately 19.25' wide by 5.25' high for a total face area of approximately 101 square feet. While it can be argued that the penthouse heating and ventilating unit would not normally be running that equipment only represents about 6 square feet of total louver area.

The next issue in this discussion is that the outdoor air louver installed does not appear to be representative of the type discussed in the RFP documents. Typically air intake louvers have a vertical front face on the front of the louver blade to help with drainage. The existing louver has the outside front face with a trough design to catch water. This may be an issue in that the existing louver is the wrong type or simply installed upside down and backwards. In either event this louver would require replacement as the existing louver has had the bird screen screwed to the interior face blades thus a reversed louver appearance would be marred.

The existing outdoor air louver equipment is too small for the described service and thus some sort of renovation has to be accomplished: Thus the following appears to be the best approach:

- A. Retain the existing outdoor air louver location and replace the existing louver with a correctly configured louver in accordance with the original RFP documents. This louver would only serve AHU-3 and HV-1 which would require approximately 88.6 square feet of face area.
- B. Provide a new penthouse west wall louver which would accommodate the needs of AHU-2 and AHU-3. This louver would be installed north of the existing west wing

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access door and configured to match vertically with the existing west wall louver. This would roughly translate into a louver, for 39,000 CFM, or about 111 square feet of face area. For a 5.25' high louver this means it would have to be roughly 21.25' long.

2. PENTHOUSE LEVEL EXISTING OUTDOOR AIR INTAKE LOUVER WATER LEAKAGE

The existing outdoor air intake louver plenum construction does not match the design build documents detail for same. The design build document detail, as shown on drawing 20043-H3.1, indicates that the outdoor air louver plenum sheetmetal is to be lapped over the bottom blade of the louver for drainage. The apparent floor leakage stains from the existing louver plenum indicate that the existing louver plenum is not built to these standards.

3. PENTHOUSE LEVEL EXISTING OUTDOOR AIR INTAKE LOUVER DEPTH SIZING

The existing outdoor air louver plenum was detailed to be approximately 36" deep to allow air to come through the louver and then slow down momentarily to drop entrained moisture before going into each duct serving individual AHU and H&V units. The existing plenum is only 20" deep which aggravates the situation with louver air intake velocities being too high. The existing louver plenum and proposed additional louver should be rebuilt/built to comply with the design-build engineers detail as those standards are correct.

4. AHU-3 OUTSIDE AIR DUCT SIZING

The existing outdoor air intake duct sizing to AHU-3 appears to be undersized. Drawing 20043-H1.2 duct sizing indicates that outdoor air intake duct velocities are approaching 2,800 FPM, which is way too high for the application in order to reduce moisture carryover as well as to reduce the load on the supply air fan. In the case of AHU-3 it has the potential to draw in rain/snow from the outdoor louver plenum and carry it across the room into the AHU air intake section. This evidently now occurs occasionally based upon the local floor flooding stains around the air intake section of that equipment. Also such high air intake velocities add power consumption to the supply fan which is needless given the large mechanical room space available for the installation of the fresh air duct.

5. AHU-1 & AHU-2 OUTSIDE AIR DUCT SIZING

The existing outdoor air intake duct sizing to AHU-1 appears to be undersized. The existing drawing 20043-H1.2 duct sizing indicates that outdoor air intake duct velocities are approaching 2,300 FPM, which is high for the application. In the case of this equipment it is equipped with a return air fan and thus the fan friction incurred for drawing in outdoor air movement is added to the supply air fan equipment static pressure needs of that system and reduces that systems' overall potential effectiveness. The existing outdoor air duct needs to be replaced as part of the installation of the new outdoor air louver equipment which would resolve moisture carry over as well as resolving issues with compromising overall AHU air handling capacity.

The outdoor intake duct sizing for AHU-2 from the outdoor louver to the AHU equipment

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appears to have been more normally sized with a peak velocity of only 2,000 FPM. While the duct sizing is slightly smaller than our office standards, approximately 1,600 to 1,800 FPM for such services, it should work. This may be a moot point with the addition of another air intake louver which is going to shorten up on the duct run anyway.

6. AIR CONDITIONING LOAD COMPARISONS FOR EACH OF 3 SECTIONS

The various building air conditioning loads have been reviewed to determine what was supposed to be accomplished under the design build contract and then compare that to what was done. A variety of cooling load scenarios have been run for each of the three major sections, west, center and east sections and compared to the original RFP requirements. There is no specific data provided relative to design conditions for each area other than an obtuse reference to 78°F for office area.

In reviewing the various areas by computer modeling the east and west wings appear to have good air side cooling capacity and a lot of additional flexibility as there is local chilled water available at each space.

The center/knuckle office area served by AHU-2, however, presented a problem in being able to match up AHU air handling capacity and potential space cooling load. A variety of computer runs were accomplished for varying degrees of occupancies and after a while it became apparent the only way we could match up the space cooling load with the existing AHU CFM capacity was to assume the exterior glazing system was tinted in lieu of the clear/low E-coated glass specified in the RFP documents. This office contacted Steven J. Wessling Architects to ascertain what the glazing shop drawings indicated for the building glazing system. The original RFP appeared to indicate that clear glazing with a low 'E' coating was to be used and the glazing shop drawings appeared to confirm that option.

In recent discussions with the operating staff direct solar impact in various spaces has been an ongoing problem regardless of local space temperature control compliance.

Our office has looked at a variety of remedial approaches and the net result of that analysis indicates that the best resolution would be to apply some sort of tinted glass film to the center/knuckle section exterior glazing. Other approaches would involve replacement of the central equipment and duct distribution systems which is totally impractical and still keep the center section in operation, let alone how to replace existing duct systems now in place. The reviewing Architect should be consulted on what kind of films are appropriate for this application and then our office could coordinate with them to assess the value/impact of the selected material. Evidently there are a variety of films available for this application, but they have to be confirmed as applicable by the glazing supplier.

7. MISCELLANEOUS BUILDING VARIABLE AIR VOLUME VALVES

There were a number of miscellaneous air valves provided, serving common areas, i.e. corridors, on the HVAC system design documents which were not referenced on the design documents for the provision of heating capacity and how to handle local temperature control. There were five such devices which during our recent inspection have already been retrofitted by the operating staff to include hot water piping and in one case a reheat coil was also added.

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8. EAST SIDE EXHAUST AND HEAT RECOVERY SYSTEM

The existing east side exhaust system remains an enigma relative to what was/is intended to be accomplished. The following questions arise:

- A. None of the exhaust ducts above the roof have their joints and/or seams sealed which is believed to be a code requirement.
- B. None of the exhaust system ducts and/or heat recovery plenums, above the roof, have any sort of insulation which would appear to defeat the purpose/efficiency of the intended heat recovery during peak cold and hot weather periods.
- C. The east side exhaust system utilizes individual exhaust fans from each lab area which discharge at roof level into a central collection duct which in turn is discharged to atmosphere by the dual central exhaust system fans. We can understand that concept and have no problem with it, however, the existing configuration has relief air being drawn at the end of the central duct collection main which would defeat the purpose of energy recovery. It is believed that this problem is related to the fact that there is no sequence of operation provided so no one understands how things are supposed to operate. In a recent site visit the building operator asked how he should be running this portion of the system as both central exhaust fans were on line. The correct procedure would be to only operate one with the second fan as a backup. Our concern is that it appears the heat recovery coil is installed so close to the central fan equipment intakes that if you were to shut down one central exhaust fan then the other fan may not properly draw the total air required for proper system operation. This issue was not investigated further other than identifying the issue. It may be that some reconfiguration of the central heat recovery coil plenum would be required to allow more room at the outlet side of the heat recovery coil to allow more room for air to enter which would also allow room for pressure relief for the fan equipment in that same section of the plenum.

9. DETAILED HVAC SYSTEM EQUIPMENT CAPACITY SHOP DRAWINGS

The existing HVAC system installation does not have the required shop drawings for the installed equipment which would include the design characteristics as finally configured. Our office has received a lot of shop drawings on how to accomplish specific maintenance functions but not the data relative to actual equipment characteristics which would have been the subject of the original shop drawings. The lack of this data has forced our office to rely upon the design documents schedules for design data comparisons, which is subject to error if the actual installed equipment problems were corrected during that period. The receipt of this data is critical for the facility maintenance records.

10. AUTOMATIC TEMPERATURE CONTROL SHOP DRAWINGS

Our office has received a copy of the temperature control shop drawings for the work but there is no english language description relative to how the equipment and controls are to work together, i.e. 'sequence of operation'. This problem needs to be corrected for record purposes

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and to aid the maintenance personnel who have to operate the facility.

11. HVAC SYSTEM AIR AND WATER BALANCING

It appears that the existing HVAC systems have not been air and/or water balanced as of yet. There are no reports on what was accomplished. The original specifications are not clear on when this activity is supposed to occur. The RFP specifications appear to provide quite detailed requirements on providing this data upon completion of the work but what is missing is providing such data when the facility is partially occupied. Balancing work is needed for those portions of the systems which are installed and the relative spaces occupied. The building management has commented that in some areas there appears to be insufficient water temperature to handle heating needs. An inspection of the design drawings indicated that the hot water system flow diagram, drawing 20042-H4.1, shows that the hot water system is to be arranged as a reverse return system which is usually almost self balancing. However, the hot water piping plans, drawing 20043-H2.1 appears to indicate a section of the piping system which is hooked up in a direct return format. Such a mixed system design format may lead to problems with out the system balanced to insure that water is available to all heating devices.

12. MISCELLANEOUS AREA HEATING PROBLEMS

There are a small number of areas where the heating equipment appears to be undersized. These areas include stairwells and end of corridors. The extent of this problem is considered relatively minor as remedial work may consist of replacing some fintube sections with convectors and replacing convectors with cabinet heaters. The areas where specific problems have been noted include the east and west end stairwells. In these areas the existing convector equipment would be replaced by appropriately sized cabinet heaters. At the end of the corridors, 4 locations, the fintube radiation would be replaced with higher capacity convectors.

13. HOT WATER SYSTEM RECIRCULATION NEEDS

The building hot water heating system piping loop is indicated to be equipped with what is termed 2-way type hot water control valves for all of the remote space heating and air system coils. On a system of this size there is normally the need to insure that some sort of hot water circulation is occurring to insure that hot water is available throughout the hot water system. Most of the time a hot water system of this type is always calling for some water flow but there may be situations where water flow in various legs is shut down due to lack of local demand. The net result is that the hot water system may lose control and/or heating capacity on isolated legs and may seem to be very slow to react to local controls. The fix in this matter would be to replace the 2-way control valves on the last heating device at the end of each hot water loop. This would require the replacement of one control valve in each of four(4) piping loops and piping in the control valve bypass line of each new control valve.

The foregoing summarizes our findings relative to issues which may/would impact the overall facility performance. Our office has not gone through and checked each and every duct and/or piping

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size as that did not appear to be relevant to the overall problems discovered.

In any event we trust the foregoing may be useful in your deliberations and shall await further instructions.

Respectfully submitted,

Richard J. Comeau, P.E.

enclosures: Attachments A, B & C

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ATTACHMENT 'C'

151 MARTINE STREET - FALL RIVER, MA

ORIGINAL FACILITY REVIEW SCOPE

The provision of services would include the following:

1. In order to evaluate the facility it is going to necessary to create a complete heating/cooling load model for the facility which can then be used as a comparison basis for the actual as-built system comparison.
2. Take the computer model heating/cooling loads and compare that to the actual equipment design capacities indicated on the design drawings. A comparison of the results of this comparison would indicate if there are basic design problems with central equipment.
3. The analysis then would look at the delivery system which provides the cooling and heating capacity to the individual equipment/spaces. The objective being to determine adequacy of delivery, duct and pipe sizing, to determine if there are weaknesses which could potentially impair performance.
4. The HVAC system controls would be reviewed for overall operation and compatibility with the overall design strategy to the extent available with control submittals and/or as-built record submittals.
5. With a completed analysis an approach would be formulated relative to corrective measures based upon the quality of the data available for review. The exact nature of the corrective measures, if any, are nearly impossible to predict without completion of the foregoing analysis. Please note that this proposal does not include the costs related to the design work for the recommended corrective measures.

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ATTACHMENT 'B'

151 MARTINE STREET - FALL RIVER, MA

PROJECT SPECIFICATION DOCUMENTATION PROVIDED FOR THE HVAC SYSTEM REVIEW:

1. ATMC RFP SPECIFICATIONS - DATED 04/03/2000
2. ATMC RFP VOLUME #1 - DATED 04/03/2000
3. ATMC RFP VOLUME #1 - UPDATED 05/05/2000
4. ATMC - LAB FITUP BULLETIN NO. 2 TAGGED EVENT #0070

HVAC SPECIFICATION - DATED 01/15/01

5. ATMC - VARIOUS EQUIPMENT OPERATING & MAINTENANCE MANUALS
(EXCLUDES EQUIPMENT CAPACITY DATA)

TRANE EQUIPMENT
PUMP EQUIPMENT
GAS FIRED HOT WATER BOILERS
MOTOR STARTERS
UNIT HEATERS AND FAN COIL UNITS
FANS
VAV BOXES
HYDRONIC REHEAT COILS

6. AUTOMATIC TEMPERATURE CONTROLS - OPERATION & MAINTENANCE MANUAL
(EXCLUDES SEQUENCE OF OPERATION)

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ATTACHMENT 'A'

151 MARTINE STREET - FALL RIVER, MA
HVAC SYSTEM DESIGN DRAWING LIST

ALL DRAWINGS ARE STAMPED AS-BUILT 11/22/02

DRAWING NUMBER	DRAWING NAME
20043-H1.1	HVAC FIRST, SECOND & ROOF DUCT PLANS - REV. 2 06/05/01
20043-H1.2	HVAC PENTHOUSE & ROOF DUCT PLANS - REV. 2 06/05/01
20043-H1.3	HVAC CORE DUCT PLAN - REV. 2 06/05/01
20043-H2.1	HVAC FIRST, SECOND & ROOF PIPING PLANS - REV. 2 06/05/01
20043-H2.2	HVAC PENTHOUSE & ROOF PIPING PLANS - REV. 2 06/05/01
20043-H3.1	HVAC SCHEDULES & DETAILS - REV. 2 06/05/01
20043-H3.2	HVAC DETAILS - REV. 2 06/05/01 *
20043-H4.1	ATMC HVAC SCHEMATICS - REV. 2 06/05/01 *

* THERE WERE TWO ISSUES OF THIS DOCUMENT RECEIVED, STAMPED AS-BUILT, BEARING DIFFERENT REVISION DATES - WE HAVE USED THE LATEST VERSION FOR OUR REVIEW.

TENANT DEVELOPMENT WORK:

20013-H1	HVAC - WEST WING FIRST FLOOR - DATED 05-17-01
20013-H3	HVAC - EAST WING FIRST FLOOR - DATED 05-17-01

THERE APPEARS TO BE A GAP IN THE DOCUMENTATION RELATIVE TO THE TENANT DEVELOPMENT WORK, I.E. THERE IS NO 20013-H2 DRAWING. DOES ONE EXIST ?



TEL (508) 255-7481
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RJC J.O. No. 71-102
June 6, 2003

151 Martine Street - Fall River, MA
Proposed Laboratory Building Renovations

This report is written in reference to the provision of HVAC system engineering services for the subject project.

Specifically the purpose of this letter is to respond to a request for an estimated cost for the accomplishing of the HVAC system remedial work described in our report submitted April 9, 2003. Your office has asked that our office estimate the value of the recommended scope of work. Please note that there are several items in our report that really fall under the responsibility of an Architect and thus we cannot reflect those potential costs. Also please note that the following estimates are subject to variation due to the method of accomplishing the work, i.e. is the proposed work to be accomplished public bid requirements and department of labor rates in affect for the various trades involved, or is the work going to be negotiated with a selected mechanical contractor, and how much of the work can be accomplished during the day versus off hours. All of the foregoing could easily add another 25-40% to the estimates given below. So be careful how you apply the numbers when considering how the work is to be accomplished.

Taking the various items in the same order we offered them in the report the following applies:

1. PENTHOUSE LEVEL OUTDOOR AIR INTAKE LOUVER SIZING:

Replacement louver & intake plenum for existing, 101 SF = \$ 39,400.00
New louver & intake plenum for second air intake, 107 SF = \$ 36,700.00
Note - new wall louver opening by others.

2. PENTHOUSE LEVEL EXISTING OUTDOOR AIR INTAKE LOUVER WATER LEAKAGE:

This corrective work is included as part of the pricing is included as part of Item No. 1 hereinbefore.

3. PENTHOUSE LEVEL EXISTING OUTDOOR AIR INTAKE LOUVER DEPTH SIZING:

This corrective work is included as part of the pricing is included as part of Item No. 1 hereinbefore.

4. AHU-3 OUTSIDE AIR DUCT SIZING

Replace existing OA intake duct for AHU-3 = \$ 35,000.00

5. AHU-1 & AHU-2 OUTSIDE AIR DUCT SIZING:

New outside air duct would tie into new closer louver

Replace existing OA intake duct for AHU-2 = \$ 29,700.00
Reconfigure AHU-1 outside air duct to new louver = \$ 7,000.00

6. AIR CONDITIONING LOAD COMPARISONS FOR EACH OF 3 SECTIONS:

This item is an engineering check item only. The work related to remediation relative to the knuckle area would be covered under the architectural work.

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7. MISCELLANEOUS BUILDING VARIABLE AIR VOLUME VALVES:

This work has already been accomplished.

8. EAST SIDE EXHAUST AND HEAT RECOVERY SYSTEM:

Relocation of existing 12" ss exhaust ductwork =	\$ 8,000.00
Relocate existing pressure relief damper, fix duct =	\$ 9,600.00
Rebuild existing ss heat recovery plenum, relocate coil =	\$ 27,000.00
Seal and insulate existing 12" ss exhaust ducts =	\$ 38,000.00
Insulate existing heat recovery coil plenum =	\$ 8,000.00

9. DETAILED HVAC SYSTEM EQUIPMENT CAPACITY SHOP DRAWINGS:

Trace down and document existing equipment real shops =	\$ 7,000.00
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10. AUTOMATIC TEMPERATURE CONTROL SHOP DRAWINGS

Trace down and document existing equipment real shops =	\$ 5,000.00
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11. HVAC SYSTEM AIR AND WATER BALANCING

Rebalance entire air & water systems =	\$ 15,000.00
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12. MISCELLANEOUS AREA HEATING PROBLEMS

New stairwell cabinet heaters(2) =	\$ 8,000.00
New corridor convectors(3) =	\$ 7,500.00

13. HOT WATER SYSTEM RECIRCULATION NEEDS

Repipe portion of hot water loop to reverse return =	\$ 16,000.00
Add 3-way control valves to several end of loop heaters =	\$ 3,000.00

Estimated raw cost of fixes =	\$ 299,900.00
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Estimated engineering costs =	<u>\$ 25,000.00</u>
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Subtotal Basic Fixes cost =	\$ 324,900.00
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Add for contingencies, 15% =	\$ 48,700.00
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Projected mechanical project cost =	\$ 373,600.00
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The foregoing represents our office's estimate on the required remedial work as well as effort to collect a more complete shop drawing file.

We trust the foregoing is sufficient for your needs at this time.

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Respectfully submitted,

Richard J. Comeau
President
Richard J. Comeau Engineers, Inc.